

What is Claimed is:

1. A method for the extraction of water from a gas stream, comprising the steps of:

5 a) contacting a gas stream comprising water with a porous adsorbent, said porous adsorbent comprising a surface modifying agent adsorbed onto a porous support whereby water is adsorbed into pores of said porous adsorbent to form a dried gas stream;

10 b) desorbing said surface modifying agent from said porous support, wherein liquid water evaporates from said pores upon desorption of said surface modifying agent and forms water vapor; and

 c) recovering said water vapor.

2. A method as recited in Claim 1, wherein said gas stream consists essentially of atmospheric air.

15 3. A method as recited in Claim 1, wherein said step of contacting a gas stream comprises forcibly moving said gas stream over said adsorbent.

4. A method as recited in Claim 1, wherein said step of recovering water vapor comprises condensing said water vapor.

20 5. A method as recited in Claim 4, further comprising the step of supplying said dried gas stream to a condenser including a heat exchanger to absorb heat generated by said condensing step.

6. A method as recited in Claim 1, wherein said pores have an average pore diameter of from about 1 nanometer to about 50 nanometers.

25 7. A method as recited in Claim 1, wherein said pores have an average pore diameter of from about 2 nanometers to about 10 nanometers.

8. A method as recited in Claim 1, wherein said surface modifying agent is a surfactant.

9. A method as recited in Claim 1, wherein said surface modifying agent is selected from the group consisting of polymers of ethylene glycol and polymers of propylene glycol.

10. A method as recited in Claim 9, wherein said surfactant is selected from the group consisting of polyethylene glycol, polyethylenimine, poly(propylene glycol) mono butyl ether, tri(propylene glycol) butyl ether, and combinations thereof.

11. A method as recited in Claim 1, wherein said surface modifying agent comprises a self-assembled monolayer.

12. A method as recited in Claim 1, wherein said porous support is selected from the group consisting of carbon, metal oxides, polymers and combinations thereof.

13. A method as recited in Claim 1 wherein said porous support comprises activated carbon.

14. A method as recited in Claim 1, wherein said porous support comprises surface-modified silica.

15. A method as recited in Claim 1, wherein said desorbing step comprises thermally desorbing said surface modifying agent.

16. A method as recited in Claim 15, wherein said desorbing step comprises applying a voltage to said porous adsorbent to generate localized heat.

17. A method as recited in Claim 1, wherein the contact angle between said liquid water and said adsorbent before said desorption step is not greater than about 90°.

18. A method as recited in Claim 1, wherein the contact angle between said liquid water and said adsorbent after said desorbing step is at least about 120°.

19. An apparatus for extracting water from a gas stream, comprising:
a) a porous adsorbent material, said porous adsorbent material comprising a surface modifying agent adsorbed onto a porous support structure;
b) a gas supply means for supplying a gas stream comprising water to said porous adsorbent material;
c) desorbing means for desorbing said surface modifying agent from said porous support structure; and
d) a condenser in gaseous communication with said porous adsorbent material and adapted to extract water vapor released from said porous adsorbent material.

20. An apparatus as recited in Claim 19, wherein said gas supply means comprises a fan.

21. An apparatus as recited in Claim 19, wherein said desorbing means comprises an electrical source adapted to apply a current to said porous adsorbent material and generate localized heat in said porous adsorbent material.

22. An apparatus as recited in Claim 19, wherein said porous support structure comprises pores having an average pore diameter of from about 1 nm to about 50 nm.

23. An apparatus as recited in Claim 19, wherein said porous support structure comprises pores having an average pore diameter from about 2 nm to about 10 nm.

24. An apparatus as recited in Claim 19, wherein said porous support structure is selected from the group consisting of carbon, metal oxides, polymers and combinations thereof.

25. An apparatus as recited in Claim 19, wherein said porous support structure comprises activated carbon.

26. An apparatus as recited in Claim 19, wherein said porous support structure comprises surface-modified silica.

27. An apparatus as recited in Claim 19, wherein said surface modifying agent is a surfactant.

28. An apparatus as recited in Claim 19, wherein said surface modifying agent is selected from the group consisting of polymers of ethylene glycol and polymers of propylene glycol.

29. An apparatus as recited in Claim 19, wherein surface modifying agent
5 comprises a self-assembled monolayer.